

CURRENT STATUS OF
TOXICOLOGICAL EFFECTS OF PCBs

Albert C. Kolbye, Jr., M.D.
Deputy Director
Bureau of Foods
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The PCBs are manufactured in the USA as Aroclors and are also imported from other countries of manufacture in a variety of unknown products.

It is likely that PCBs have been getting into environmental circulation for a period of years, although such contamination on an environmental scale has only been recognized recently in the past few years.

Residues have been found in a variety of foods as a result of either direct contact with materials containing PCBs or as a result of biological uptake of PCBs circulating in the environment.

What is the toxicological significance of PCBs? I would like to briefly summarize data derived from animal experiments and from human intoxications.

While the oral LD^{50} in mammals varies from about 2 to 10 gms/kg, substantially smaller doses adversely affect egg production in birds. Chick embryo studies indicate that lethal effects decrease with increases in the chlorine content of the PCBs, and that a variety of birth defects can result from PCBs tested in this sensitive system.

Rats experience growth depression and increase in liver size when dosed with 1,000 ppm in the diet; however, induction of certain enzymes has been noted at levels as low as 25 ppm in the diet. Generally, enzyme induction increases with increases in chlorination of PCB. Pathologically, monkeys given 1.4 to 16 mg/day PCBs in their diet showed liver cell enlargement, fatty degeneration, and an increase in the smooth endoplasmic reticulum of the liver cells indicating fibrotic changes. Reflecting alteration of liver metabolism, changes in hexobarbital sleeping time and other enzymatic related detoxification steps were noted.

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largely related to induction of hepatic hydroxylating enzymes. Pericardial edema has been noted and may possibly in part be the contaminating presence of chlorinated dibenzofurans in oil manufacture.

At levels around 100 ppm in the diet, adverse reproduction with decreased litter size and survival have been noted in increases noted in liver and thyroid weights. Obviously PCBs inhibit metabolism by inducing certain enzyme systems and undoubtedly others. It is likely that such changes adversely affect the action of hormones and pesticides, not to mention the relatively unknown area of interactions with therapeutic drugs.

We know that PCB residues have been found in human fat at levels of 60 ppb. However, little is known about the metabolism of PCBs themselves in animals and humans.

Human intoxication with Kanachlor 400, a PCB manufactured with 48% chlorine, but unknown chemical characteristics as was noted when a heat exchanger leaked into rice oil which was used by Japanese families in 1968. About 600 people were eventually treated. Exposure levels to the oil were calculated to approximate 1 liter. The oil itself was apparently contaminated at levels estimated from 200 to 2,300 ppm PCBs, but the origin of the lower figure given in the particular Japanese publication and is currently under investigation. The higher figure is derived from the known chlorine content of rice oil related to the known organic chlorine content of Kanachlor 400.

The clinical problems associated with Japanese Yusho incident included chloracne, blindness, systemic gastro intestinal symptoms with jaundice, edema, and abdominal pain. Birth abnormalities were noted in that a few babies were born with decreased birth weights and skin discoloration which later regressed. Nothing is known as to whether or not these children have experienced permanent liver damage or alterations in liver function or metabolic detoxification of hormones, etc. Nothing was described in relation to thyroid function which you will remember was noted apparently to be affected in animals. Transplacental transmission of PCBs were noted by the presence of residues in fetal tissue.

To summarize what is presently known, the no-effect level in test mammals may approximate 10 ppm in the diet. Based on this animal data with allowance for a 1,500 gm human dietary food intake, the ADI would permit a 100-fold margin of safety if set at 150 μ gms PCBs per day.

From the observations available to us concerning Yusho, the lowest reported figures estimate a minimal positive effect level at 3 mg per day even though the average doses to these Japanese may have been higher. Using a tenfold safety margin, we could roughly estimate that 300 μ gms/day would be without overt effect although possibly subtle changes in liver function may still occur.

Thus animal and human data both point to 150 to 300 μ gms/day as being in the range of consideration for establishing an acceptable daily intake for the period of time that we as a society are forced to tolerate the presence of these chemicals in our food supply, but I would like to emphasize that we know very little about the potential metabolic consequences to long-term PCB exposures even at these low levels.

In further consideration of low-level exposures, we can predict that since 2 gms was reported to be the total dose necessary to cause an effect in the Japanese, then 200 mg would be an estimated total safe ingestion over an extended period of time. I emphasize that I am now talking total accumulated exposure and not a daily exposure.

Our previous lowest estimate of a safe dose was 150 μ g/day based on animal data or 300 μ gm/day based on human data. With a total allowable ingestion of 200 mg we could estimate a safe period of intake of 44 months based on the 150 μ gm/day animal exposure data or 22 months at the 300 μ gm/day level based on human data.

If we can assume new regulatory approaches will bring the problem under better control within 6 months, this would permit 1.1 mg/day of PCB in the dietary intake for the next six-month period only as a temporary measure.

At a level of 5 ppm this allows total intake of 200 grams food.

At a level of 4 ppm this allows total intake of 250 grams food.

At a level of 3 ppm this allows total intake of 330 grams food.

At a level of 2 ppm this allows total intake of 500 grams food.

At a level of 1 ppm this allows total intake of 1 kilogram food.

Deelnemerslijst PCB conferentie 20 sept. 1972.

Dr. J. Bonnema	Keuringsd. van Waren, St. Jansstraat 4	Groningen
Ir. H.W.L. Bruckman	Keuringsd. van Waren, Florijnruwe 111	Maastricht
Drs. Cirkel	Sigma Coatings BV, Oostzijde 39	Zaandam
hr. H.R. Collet	Monsanto Europe SA (Monsanto, J. v. Nassaustr. 53, Den Haag)	Brussel
Dr. T. Doorgeest	Verfinstituut TNO, Postbus 203	Delft
Dr. C. Engel	Centraal Inst. Voedingsonderzoek Utrechtseweg 48	Zeist
Drs. G.J. van Esch	Rijks Inst. voor de Volksgezondheid, Lab. voor Toxicologie, Postbus 1	Bilthoven
Mej.Dr. C. Eikelenboom	Scheikundige bij Keuringsdienst van Waren, Prinsegracht 50	Den Haag
- G.H. Feskens	I.E.O. Transformatorenfabriek NV Postbus 286	Breda
Mr. Fowler	ICI Holland NV, Postbus 551 (Mond Division)	Rotterdam
<i>Sad Task Force Report</i> <i>Chairman</i> Prof. H. van Genderen	Inst. Vet. Farmacologie en Toxicologie, Biltstraat 172	Utrecht
Dr. P.A. Greve	Rijks Inst. voor de Volksgezondheid Postbus 1	Bilthoven
→ Dr. H.J.A. Groen	Hoofdinsp. van de Volksgezondheid voor de Hygiëne v/h Milieu Dr. Reyersstraat 8	Leidschen- dam
A.Th. Groot Wesseldijk arts	Philips Medische Dienst	Eindhoven
G.P.A. Hulsing	Mobil Chemie Postbox 130	Delft
<i>Chapman</i> <i>A-60</i> Prof.Dr. J.H. Koeman (Co-Moderator)	Landbouwhogeschool De Dreyen 11	Wageningen
Mej.Dr. A. Kaars Sijpesteijn	Organisch Chem. Instituut Crossestraat 79	Utrecht
D. Keome	ICI Holland NV Postbus 551	Rotterdam
Drs. F.B.J. Koops	Kema NV Utrechtseweg 310	Arnhem
Dr. H.E. Kronenberg	Studie- en Inform.centrum TNO voor Onderzoek ten dienste van het Milieubeheer, Postbus 186	Delft

Drs. A. Kruijsse	Hoofdinspectie van de Volksgezondheid op het gebied van levensmiddelen en de keuring van Waren, Dr. Reyersstraat 10	Leidschen-dam
Mej. M.B. van Lennep	Centrale Organisatie TNO, Postbus 297	Den Haag
Dr. F.E. Loosjes	Hoofdinspectie van de Volksgezondheid voor de Hygiëne v/h Milieu Geertjesweg 15	Wageningen
Dr. Ir. A. Ohm	Technisch Bureau Brandschadepreventie, Eemnesserweg 56	Baarn
Dr. J.C. Overeem	Organisch Chem. Instituut TNO Croesestraat 79	Utrecht
F.L. Pelt	Landbouwhogeschool	Wageningen
P.J.A. Marsh	Monsanto Europe SA (Monsanto NV, J.v. Nassaustr. 53, Den Haag)	Brussel
Drs. L.S. Schuddeboom	Hoofdinspectie van de Volksgezondheid voor de Levensmiddelen, Dr. Reyersstraat 10	Leidschen-dam
Dr. R. Sijderius	Kema NV, Utrechtseweg 310	Arnhem
Ir. G.E. Standhardt	Mobil Chemie, Postbox 130	Delft
Drs. H. van der Velden	Keuringsdienst van Waren, Nieuwe Gracht 3	Haarlem
Dr. H.G. Verschuuren	Rijks Inst. voor de Volksgezondheid Postbus 1	Bilthoven
Dr. J.G. Vos <i>Dioxin- & di-benzo furan</i>	Fac. der Diergeneeskunde Pathologisch Instituut Biltstraat 172	Utrecht
Ir. R.H. de Vos	Centraal Inst. voor Voedingsonderzoek Utrechtseweg 48	Zeist